YOUR SUPPORT TOUCHES MY HEART: TESTING A MEDIATIONAL MODEL OF RECEIVING SOCIAL SUPPORT, CULTURE, AND AMBULATORY BLOOD PRESSURE

by

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ABSTRACT

Social support is a reliable predictor of psychological and physical health. However, received social support can result in either improvements or detriments to health depending on contextual processes. The cultural facet of independence-interdependence – cultural variations in social orientation and self-schema – is a macro level of analysis that may determine when receiving social support results in benefits or costs to health. The current study examined whether solicited and unsolicited received support results in either health improvements or health costs. The study consisted of 148 participants in the United States and Japan who completed a 2-day ambulatory blood pressure and daily diary protocol. Multilevel modeling was used to account for the data dependence across repeated measures as well as to examine both effects of support at the individual and cultural level. Mediational bootstrapping analyses and moderated mediational analyses were used to examine whether changes to self-schema variables mediated the relationship between support and health and whether culture served as moderator of these indirect effects. No consistent evidence was found to support these hypotheses. However, some evidence for cultural differences and for the stress-buffering effects of social support on ABP were observed. Implications are discussed.

This dissertation is dedicated to my family, kin, and friends – who kept my blood pressure low, my social support high, and my laughter loud as I completed this journey.

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INTRODUCTION

Social support reliably predicts health (Holt-Lunstad, Smith, & Layton, 2010; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). However, for as much data that exist attesting to the beneficial effects of social support on health, there is also evidence showing social support can be deleterious to both psychological well-being and physical health (Barrera, 2000). Thus, understanding the pathways by which social support differentially results in either improved or detrimental health functioning has valuable implications for theory and application. Culture, particularly the cultural dimension of independence-interdependence social orientation, is a compelling macro level of analysis in which social support processes are embedded. Examining this level of culture may also determine the divergent pathways that govern when, how, and why social support results in either benefits or costs (Uchida, Kitayama, Mesquita, Reyes, & Morling, 2008).

Humans are social animals. We seek, develop, and maintain relationships throughout the lifespan (Baumeister & Leary, 1995; Bretherton, 1985). Social support during stressful and positive events are universal aspects of these relationships. Furthermore, social support influences not only the quality of our lives, but the quantity as well. A recent meta-analysis of over 300,000 participants found social support predicted decreased all-cause mortality risk even after controlling for initial health status (Holt-Lunstad et al., 2010). This effect size was comparable to traditional predictors like smoking and exercise. Social support is also associated with improved psychological well-being (e.g., self-esteem, relationship quality, mental illness risk, symptom severity,

and prognosis) in addition to better physical health (e.g., acute cardiovascular, endocrine, immune function, and risk of chronic illness) (Berkman, Glass, Brissette, & Seeman, 2000; Darbonne, Uchino, & Ong, 2012; Lyubomirsky, King, & Diener, 2005).

Broadly, social support can refer to either structural support, such as the number and diversity of social ties and contact frequency, or functional support, such as specific types of support (see Table 1) (Cohen & Wills, 1985). Functional support can further be distinguished between whether it is perceived support – an internal, stable perception that aid or resources in one's network are readily available should they be needed – or whether it is received support – the actual, enacted support transaction between provider and recipient (Cohen & McKay, 1984). However, perceived and received functional social support only correlate modestly (Kaul & Lakey, 2003; Lakey & Lutz, 1996; Sarason, Sarason, & Pierce, 1990). This conceptual distinction also has implications in understanding support's effects on health. Whereas perceived functional support is relatively stable over time and consistently predicts improved functioning, the findings for received social support are mixed (Krause, 2001; Roy, Steptoe, & Kirschbaum, 1998). Across studies, received social support is regularly found to result in both improved health function, such as lower ambulatory blood pressure, and poorer health function, such as increased distress, physiological reactivity, and even mortality risk (Bolger, Zuckerman, & Kessler, 2000; Glynn, Christenfeld, & Gerin, 1999; O'Donovan & Hughes, 2008; Uno, Uchino, & Smith, 2002). This is due to the presence of contextual factors (e.g., provider, recipient, dyad, and situation) operating in received support transactions that are uniquely inherent to received rather than perceived support (Barrera, 2000; Bolger & Amarel, 2007; Wills & Shinar, 2000).

For example, one theoretical model posits that receiving support results in higher stress, negative affect, and physiological stress reactivity when the support is received, but was unsolicited and unwanted. This unsolicited support is harmful to health because it threatens the recipient's appraisals of his or her competency, autonomy, and self-esteem while also increasing threat appraisals of the stressful event (Bolger & Amarel, 2007). This model proposes that once a stressor occurs, an individual must first appraise the event to determine if it is beyond his or her coping ability before deciding if a request for social support will be made or is wanted. Thus, support that is received before the individual decides it is wanted and makes the request is viewed as unsolicited. Alternately, this model posits that soliciting social support may be less likely to activate these concerns for the individual as it maintains or even bolsters the recipient's autonomy and self-esteem while also providing coping resources. This model also allows that certain types of functional social support – such as informational support as opposed to emotional support – may more easily activate concerns over competency and self-esteem due to its objective (e.g., giving advice rather than affirmation). Thus, differential hypotheses can be made for different support functions.

However, virtually all of the models examining received functional support yield from Western European and American samples (Thorsteinsson & James, 1999). Past cross-cultural work suggests that these regions of the world are considered to be predominantly independent and individualistic in their social orientation (Oyserman, Coon, & Kemmelmeier, 2002). Cultural independence-interdependence refers to cultural variations in social orientation, self-schema, and goals (Triandis, Bontempo, Villareal, Asai, & Lucca, 1988). Within independent cultures, the self is construed as autonomous,

independent, and defined by personal accomplishment. Here, individual goals receive priority for the self over group or social goals. Within interdependent cultures, the self is construed as interrelated, harmonious, and defined by social relationships and hierarchy more than personal accomplishment. Here, group goals receive priority over individual goals. Indeed, cultural independence-interdependence systematically influences a wide range of psychological phenomena, including cognitive, emotional, motivational, and social processes (Markus & Kitayama, 1991).

When prior theoretical models developed in independent cultural contexts were empirically examined in other cultural contexts, there was, by and large, failure to replicate (Kim, Sherman, Ko, & Taylor, 2008). Indeed, preliminary evidence suggests that because the cultural social orientation differences are strongly interpersonally focused, cultural social orientation is an important determinant of the pathways linking social support and health. First, interdependent individuals reported being less likely to seek support as a coping resource relative to participants from independent cultures (Kim, Sherman, & Taylor, 2006; Taylor et al., 2004). Interdependent participants also showed higher negative affect and stress after imagining receiving emotional and informational support relative to participants in independent cultures (Kim et al., 2006). Interdependent participants exhibited higher blood pressure reactivity and cortisol production as a result of a laboratory stressor after a received support prime compared to a structural support prime and compared to independent participants who received support (Taylor, Welch, Kim, & Sherman, 2007). Such data could be interpreted to mean that the psychological costs of receiving support are uniquely tied to the cultural context in which support occurs. Subsequently, the psychological and physiological costs may outweigh any

possible benefits of received social support in interdependent cultures due to activating culture-specific self-schema concerns, such as loss of face (e.g., status, norm adherence), threats to social harmony, relational inequity or debt, and highlighting one's disconnection from his or her valued social group (Taylor et al., 2004; Uchida et al., 2008).

However, the data from interdependent cultural contexts tell a more complex story. Uchida et al. (2008) found that perceived emotional support did predict higher mental well-being in Japan (interdependent orientation), replicating similar associations of perceived support's benefits in the United States (independent orientation). Interestingly, self-esteem also fully mediated the association between support and well-being in the United States sample only. Subsequently, Uchida et al. proposed that rather than social support being altogether costly in interdependent cultures, as was previously proposed, it was solicited received social support driving the effects in prior studies. Indeed, past studies asked participants about requesting help, rather than simply receiving it. Contrary to independent cultures where solicited support is valued for its affirmation of self-efficacy, it may be costly in interdependent cultures as it makes salient the self as socially disconnected or unharmonious (Taylor et al., 2007; Uchida et al., 2008). Within an interdependent culture, soliciting support explicitly creates relational debt through its direct nature, requires the recipient experience loss of face (e.g., requesting means he or she cannot handle the stressor), and suggests to the individual that he or she is not harmoniously connected with his or her ingroup, as his or her group members would have otherwise detected distress and preemptively offered support unsolicited in a more indirect manner. This is a critical contrast, as earlier models developed in independent

cultures posit that unsolicited support is most costly to well-being as it means the self is incompetent or not autonomous (Bolger & Amarel, 2007).

Importantly, in keeping with the proposal of Uchida et al. (2008), prior studies documenting costs of social support in interdependent cultures overwhelmingly examined solicited support. Without considering the cultural landscape in which support occurs, neither model sufficiently predicts the effects of social support on health. However, the Bolger and Amarel (2007) and Kim et al. (2008)/Uchida et al. (2008) models are also similar in that support which has the unintentional effect of jeopardizing a culturally-valued self-schema can be detrimental to psychological well-being and physical health. Inversely, support that happens to promote these same cultural self-schemas will in turn result in improved psychological well-being and physical health.

In one experiment testing these ideas, participants worked on a math task that gradually increased in difficulty (Mojaverian & Kim, 2013). After participants received task instructions stating they could request help from a confederate, confederates provided informational support on difficult questions. For participants in the unsolicited support condition, the confederate immediately provided assistance when participants reached the difficult questions before a request was made. For participants in the solicited support condition, the confederate only provided assistance when participants directly requested help. In a replication of prior self-report findings, Asian American participants requested help on fewer problems overall. However, Asian American participants in the randomly assigned solicited support condition also rated the task as more stressful. They also reported reduced state self-esteem relative to interdependent participants in the unsolicited support condition and European American participants in either condition.

Importantly, a follow-up study used vignettes to compare solicited support, unsolicited support, a stressful event with no support, and a stressful event of which social ties were aware but did not provide support ("officiousness"; Mojaverian & Kim, 2013). Indeed, in further support of the notion that solicited support is harmful in interdependent cultures due to preemptive support not being provided from the group, interdependent participants had the highest positive affect in the unsolicited support condition. Importantly, there were no significant differences in positive affect for participants in the officiousness and solicited support condition, which was significantly lower than in the unsolicited support condition.

These studies provided a well-controlled empirical test of the role of solicited and unsolicited support across cultures. However, there are several opportunities to expand and refine the empirical support for this model. First, this study only examined the informational function of support. However, prior work shows that the likelihood of incurring health costs or benefits differs substantially by function of support, regardless of solicitation. However, prior cultural comparisons of support and health have been limited to emotional and informational support (Mojaverian & Kim, 2013; Taylor et al., 2004; Uchida et al., 2008). For example, as emotional support's function is to increase self-esteem and self-efficacy, it may be less harmful relative to other functions even when unsolicited in an independent culture (see Figure 1). Given that belonging support's function is to increase social connectedness and belonging, it may also be less costly even when solicited within interdependent cultures. Second, more details on the cultural groups in the study were not provided beyond Asian and European American. Thus, it is unknown if both cultural groups were homogeneous in whether they were born in the

United States or if these samples also included first-generation Americans or a combination of both domestic and international students. This may influence results as prior work shows that first-generation Asian Americans may exhibit qualities of both independent and interdependent self-schema and cognitive styles and may shift between them as a result of priming (Kim et al., 2006). Thus, a more stringent test of these ideas may be to examine samples from two countries that generally differ in cultural independence-interdependence. Furthermore, one major assumption in past cultural work is the use of country or ethnic group as a proxy for culture. However, individuals, generations, regions, and genders within one country can also vary in the degree to which cultural orientation is endorsed (Gjerde, 2004; Killen & Wainryb, 2000; Oishi, 2010). By measuring and including cultural orientation and values related to independence and interdependence in our statistical models, the effects of cultural orientation may be more clearly observed. Third, the support provider in this study was a confederate. Though the researchers tested for and found no difference for whether the confederate was matched to the participants' ethnicity, participants were informed that the confederate was a math major working on an unrelated task. However, cultural differences in social support processes are also impacted by whether the provider is perceived as an ingroup or outgroup member (Kitayama & Uchida, 2003; Triandis, McCusker, & Hui, 1990). The support provider in the current study is a stranger, with no likely opportunity for reciprocity by the recipient in the future due to the artificial nature of the experiment. Thus, it is difficult to generalize whether these findings would replicate similarly when occurring within established relationships between ingroup members.

Finally, this study did not collect indices of physical health and only one study of

support processes has included direct measures of physical functioning. Epidemiological research in Japan shows somatic complaints and perceived health status, as well as health outcomes (e.g., mortality), are related to perceived social support among elderly participants (Jou & Fukuda, 1997, 2002; Okabayashi, Liang, Krause, Akiyama, & Sugisawa, 2004; Okamoto & Tanaka, 2004; Sugisawa, Liang, & Xiu, 1994; Wang et al., 2005). One limitation is that psychological reports of distress and psychological well-being do not always reflect actual physiological functioning (Uchino, Bowen, Carlisle, & Birmingham, 2012). Additionally, it is unknown what acute physiological processes occur earlier in the lifespan that cumulatively contribute to these long-term health outcomes. However, virtually no studies have examined these pathways using real social relationships and direct measures of physical functioning in the real world. Thus, we know very little of how these social support pathways may contribute to physical functioning that contributes to the likelihood of morbidity and mortality.

Thus, the primary aim of the current study was to examine cultural differences between independent and interdependent orientation in daily life on how unsolicited and solicited support from direct network relationships differentially impact both psychological well-being (affect, perceived stress) and physical health (ambulatory blood pressure) (see Figures 1 and 2). The study examined both European-Americans participants in the United States as representatives of cultures with a predominantly independent social orientation and East Asian participants from Japan as representatives of cultures with a predominantly interdependent social orientation.

In particular, evidence for the impact of social support on cardiovascular function has been well-documented in cultures with an independent orientation across multiple

indices of cardiovascular health, including acute cardiovascular reactivity (CVR), ambulatory blood pressure (ABP), coronary artery calcification (CAC), inflammatory markers, and even cardiovascular mortality and morbidity (Bowen et al., 2013; Holt-Lunstad et al., 2010; Kop et al., 2005; Lepore, Allen, & Evans, 1993; Lutgendorf, Anderson, Sorosky, Buller, & Lubaroff, 2000; Uchino et al., 1996). Cardiovascular disease (CVD) is the leading cause of death in the United States and in many industrialized nations (Hoyart & Xu, 2011). Thus, understanding the pathways between social support and cardiovascular function has important implications for improving the effectiveness of both prevention and treatment. Of these acute functioning measures, ABP is recognized as a more reliable and accurate measure of individual blood pressure above and beyond clinic readings as well as a more reliable, cost-effective predictor of CVD risk (Björklund, Lind, Zethelius, Berglund, & Lithell, 2004; Perloff, Sokolow, & Cowan, 1983; Pickering, Harshfield, Devereux, & Laragh, 1985). We predicted that solicited support would be associated with lower ABP, lower stress, higher positive affect, and lower negative affect in independent cultures and higher ABP. In contrast, solicited support was predicted to be associated with higher stress, lower positive affect, and higher negative affect in interdependent cultures (see Figure 2). We also predicted that unsolicited support would be associated with lower ABP, lower stress, higher positive, and lower negative affect in interdependent cultures and higher ABP, higher stress, lower positive affect, and higher negative affect in independent cultures. However, it was also hypothesized that in independent cultures, emotional support would positively affect health independent of solicitation, whereas in interdependent cultures, belonging support would positively affect health independent of solicitation (see Figure 1).

A second aim of this study was to examine the mediating pathways underlying the relationship between solicited/unsolicited support and health (see Figures 1 and 2). The emerging cultural models of social support suggest that "person" variables, such as self-esteem, may mediate the effects of social support on well-being (Uchida et al., 2008). However, one limitation to these past approaches is the use of self-esteem as the mediating variable, yet self-esteem is consistently lower and less variable in interdependent cultures, such as Japan. Motivational processes for self-esteem maintenance or enhancement and the self-serving bias is also less common in these cultures (Heine, Lehman, Markus, & Kitayama, 1999). Thus, examining only self-esteem as a potential mediator fails to consider that in interdependent cultures, the link between support and well-being may also be mediated by social self-schemas, such as collective-esteem, collective-efficacy, or social assuredness, rather than by person variables (e.g., self-esteem, self-efficacy, personal control). Thus, it may be that no mediational pathways are found in interdependent cultures due to a selection of variables more central to independent cultures.

Finally, the stress-buffering hypothesis posits that social support – if beneficial – may indirectly affect physical health by reducing stress appraisals, increasing coping appraisals, and bolstering positive self-schemas (Cohen & Wills, 1985). In turn, this buffer against psychological stress downregulates physiological stress responses. For example, unsolicited support is a culturally appropriate form of social support in an interdependent culture; it might bolster sense of social assuredness, collective efficacy, and collective self-esteem, thus reducing stress, negative affect, and consequently, ABP. Inversely, solicited support may threaten and reduce these same mediating variables,

resulting in higher stress, negative affect, and consequently, ABP. As such, the second aim was to examine the mediating variables linking social support to well-being and health (see Figures 1 and 2). That is, when these culture-specific self-schema variables are raised or lowered as a result of receiving culturally preferred forms of social support (e.g., soliciting, function), it may account for the effects of support on health. Thus, we predicted that these effects of soliciting social support on health would be mediated by whether or not social support increased or reduced culturally valued self-schema variables (see Figures 1 and 2). In interdependent cultures, we hypothesized that the effects would be mediated by whether social connectedness, collective self-esteem, and collective efficacy increased or decreased. In independent cultures, we predicted that the effects would be mediated by whether self-esteem, self-efficacy, and personal control increased or decreased.

The current study tested a model of cultural pathways of support and health that accounts for the differential prior findings on received social support. The study examined whether changes to culturally valued self-schema mediated the effects of two health-relevant social support factors: 1) solicitation of social support and 2) function of support. The study used an ambulatory ecological-sampling approach in two cultural samples (United States as independent, Japan as interdependent). Analyses included bootstrapping mediational analysis as well as multilevel modeling to consider both fixed and random effects. Participants in the study will completed a 2-day ABP protocol in which ABP and a daily diary of social interaction was assessed once within 60 minutes.

Table 1

Definition and examples of different support constructs and functions

Type of Support	Definition	Example
Structural Support	Social network composition	Number of contacts, frequency of contact, type of contacts
Functional Support	Types of social support one may receive from relationships; Can be perceived or received	Emotional, Belonging, Tangible, Informational support
Perceived Support	The expectation that other will provide support if need.	Perceiving that your friends will be there for you no matter the circumstance.
Received Support	The actual provision of support by another	Your friend directly provides you with support to handle an important problem.
Emotional (Self-esteem)	Expressions of comfort and caring	Someone who makes you feel better just because they listen to your problems.
Belonging	Shared social activities, sense of social belonging	A friend who you enjoy simply "hanging out" with.
Tangible (Instrumental)	Provision of material aid	A family member who could give you a personal financial loan.
Informational (Appraisal)	Provision of advice and guidance	A person who can give you trusted advice and guidance on an issue.

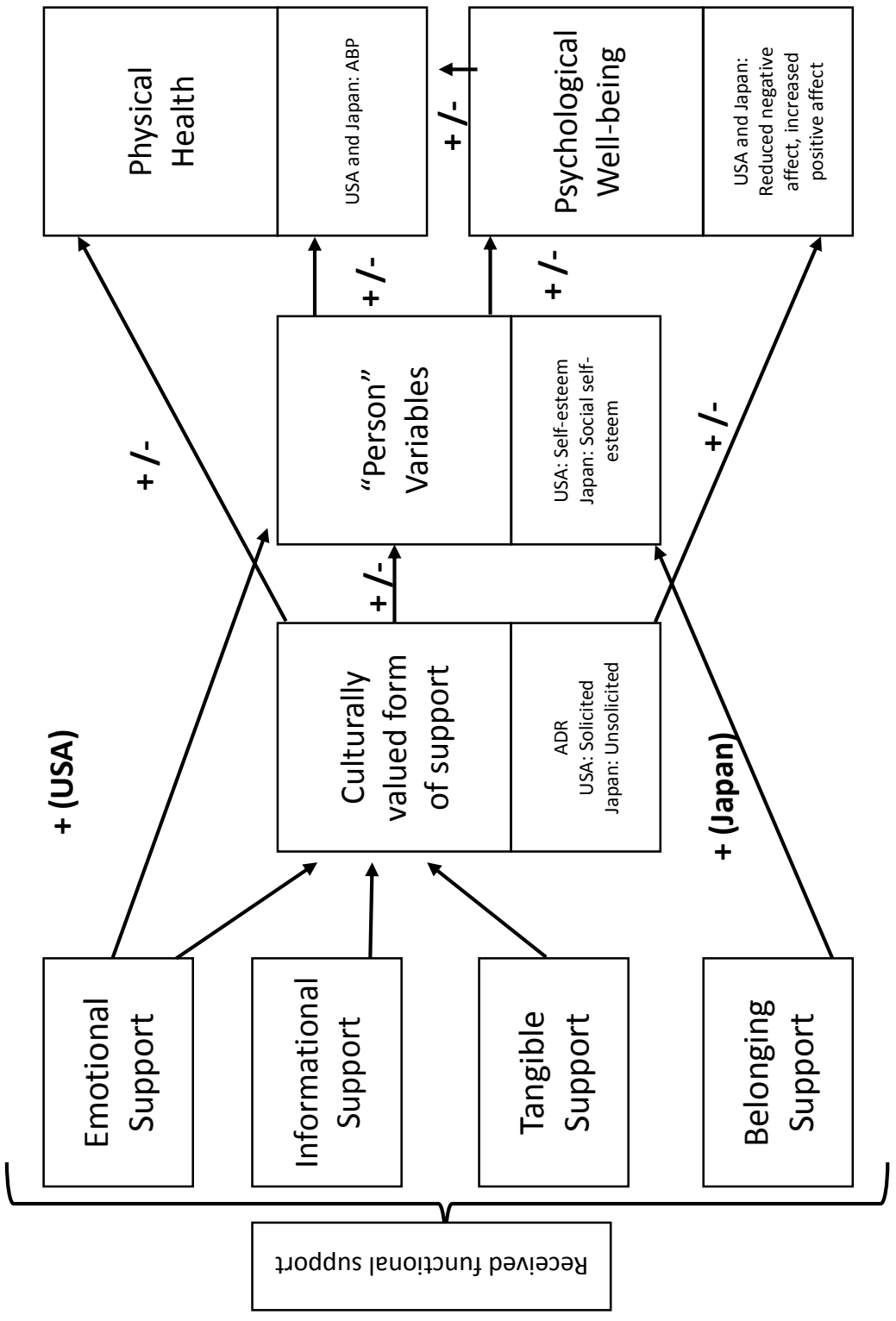

Figure 1 Aim 1 and 2: Differential pathway linking belonging support to ABP and psychological variables compared to other functions of received social support.

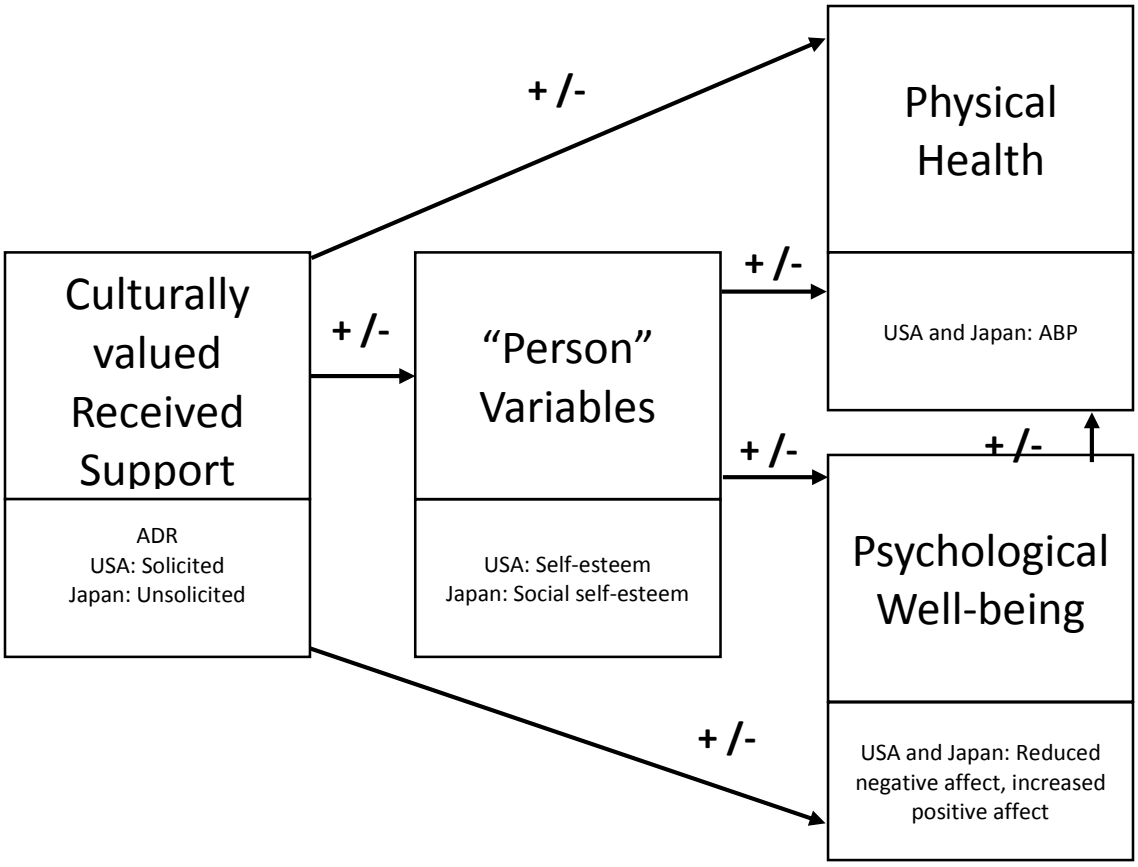

Figure 2 Aim 1 and 2: Mediational pathway linking received social support with ABP and psychological variables moderated by culture.

METHODS

Participants

Participants were 74 resident American college students and community participants recruited from the University of Utah and 74 resident Japanese college students and community participants recruited from Kyoto University. Participants were between the ages of 18 to 35 (see Table 2). Criteria from prior work was used to select relatively healthy participants to rule out potential extraneous influences on cardiovascular function (Cacioppo et al., 1995): 1) no prescription medication use which is known to influence cardiovascular functioning (e.g., beta blocker), 2) no history of medical diagnosis with a known cardiovascular component (e.g., diabetes), 3) no recent history of a psychological disorder diagnosis (e.g., depression). Participants were recruited from their respective university psychology participant pool and flyers posted in the community. Participants from the University of Utah were compensated in course credit or monetary compensation whereas participants from Kyoto University were compensated in gift cards, as per the respective pool policies ($50 for their time or 5.00 hours of course credit). All participants received informed consent and debriefing and were treated according to APA Ethical Guidelines. Prior to commencing, the study was reviewed and received exemption by the University of Utah Human Subjects IRB.

Measures

Baseline Measures

Interpersonal Support Evaluation List (ISEL). The ISEL intends to measure global perceived functional social support and the four domain functions of emotional, belonging, tangible, and informational support across 40 items (reliability α=.88) (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). The scale possesses good validity.

Two-Way Social Support Scale Giving Subscale (2WSS). 2WSS is a 10-item measure of perceived giving emotional and instrumental social support with psychometrically sound reliability and validity (Shakespeare-Finch & Obst, 2011).

The Physical Health Questionnaire-15 (PHQ-15). The PHQ-15 is intended to briefly measure self-reported physical health and somatic symptoms across different physical health indicators (e.g., gastrointestinal, pain, respiratory) using a 3-point Likert-styled scale on 15 items relevant to overall health (Kroenke et al., 2002). It has good reliability and validity. Additionally, a 1-item global subjective physical health rating on a 7-point Likert scale will be used.

Patient Health Questionnaire-4 (PHQ-4). The PHQ-4 is intended to be a brief measure of depression (2 items) and anxiety (2 items) in nonclinical samples with good reliability and validity (Löwe et al., 2010).

Positive and Negative Affect Schedule (PANAS). The PANAS was designed to assess bi-dimensional mood in 20-items on a 5-point Likert scale (Watson, Clark, & Tellegen, 1988). For the purposes of this study, the daily time scale will be used for the daily-diaries while the past 2-week timeframe will be used at baseline. The measure has good reliability and validity.

Contingencies of Self-Worth (CSW). The CSW is a measure designed to assess trait self-esteem, conceptualized as domain-contingent and variable across individuals (Crocker CITE). The seven domains assessed over 35 items, using 7-point Likert scales, differed within Japan and the United States based on past psychometric pilot testing in order to maintain construct validity. In the U.S., the domains included other's approval, physical appearance, competitive accomplishments, academic competence, family, morality, and God's love. In Japan, the God's love subscale is replaced by the domain of relational harmony. In both countries, it is psychometrically sound, with good reliability and validity.

Demographics. Demographics were collected at baseline, including age, sex, physical activity, alcohol and caffeine consumption, medication use, country of origin, and residence. Additionally, participants reported on structural support items, including relationship status, living arrangement, number of social contacts or organizations, and time spent in person/using social network for interaction. Participants also reported how frequently they moved residences in their lifetime and whether they planned to move in the future.

Health behaviors. A health behavior self-report survey based on past work was also used in order to compare participants to exclusion criteria of the current study. Participants reported on health diagnoses, medication use, exercise and activity level, diet, alcohol, caffeine, and nicotine consumption, as well as general perceived health.

Predictors

In the ADR (see below), participants were asked whether they received, solicited, and provided functional social support. That is, participants were asked if they received or provided support (emotional, informational, belonging, tangible support) since the prior ABP assessment (1= not at all, 5=a lot) and were also ask to endorse each function of support that occurred (emotional, informational, belonging, tangible support; 1= yes, 2= no) (Cohen et al., 1985). A second overall support variable was also created by combining these four functions into one composite variable as has been done in past work (Bowen et al., 2013; Cohen et al., 1985). For the item regarding solicited support – due to cultural differences in the linguistics of requesting support – an item that could include both direct and indirect requests by the recipient was used (e.g., "Who initiated this support? Me= 1, Other person= 2"). Finally, the ADR also asked the degree to which participants felt understood, cared for, and accepted from the support and how satisfied or helpful they found the support (1= not at all, 7= very much; Leary & Baumeister, 2000; Mojaverian & Kim, 2013).

Mediators

Daily diary measures of self-schemas were included based on prior daily-diary work by this research team. Participants used a Likert-scale to report on state self-esteem, collective self-esteem, and social assuredness (1= not at all, 5= extremely). These seven items were drawn from the State Self-Esteem measure (4 items; "I feel concerned about the impression I am making," "I feel I am as adequate or worthy as others," "I feel displeased with myself"; Heatherton & Polivy, 1991), from the Social Assuredness Scale (2 items; "I feel disconnected from those around me," "I feel harmonious with those

around me"; Lee & Robbins, 2002), from the Collective Self-Esteem Scale (1 item; "I feel good about the social groups to which I belong"; Luhtanen & Crocker, 1992), and from past work on social relationships and social interactions as a source of self-esteem (1 item; "Others would say I am a reliable person"; Leary, 2005; Leary & Baumeister, 2000). Finally, participants also reported their level of stress over the past hour using the 1-item stress measure in which participants report the extent to which they experienced a situation in which they felt tense, restless, overwhelmed, or nervous (1= not at all, 5= extremely; Elo, Leppãnen, & Jahkola, 2003). The state self-esteem items were combined to create a composite self-based self-esteem variable while the state collective self-esteem and social assuredness items were combined to create a composite social-based self-esteem variable.

Outcomes

Ambulatory systolic and diastolic blood pressure were assessed at a randomly selected time within each 60 minutes over the working day until sleep over 2 work/school days. [See materials for further details]. An abbreviated form of the Profile of Mood States (McNair, Lorr, & Droppleman, 1971) assessed state affect on dimensions of both positive (e.g., on edge, uneasy, anxious, nervous) and negative affect (e.g., sad, discouraged, hopeless, worthless), which were selected for use in past daily diary studies as these four items loaded highest on factor analysis for anxiety and depression (Bolger et al., 2000).

Materials

Baseline Blood Pressure

A Dinamap Model 100 monitor measured SBP, DBP, and HR at baseline (Critikon Corporation, Tampa, Florida) (for averages, see Table 3). The Dinamap uses the occillometric method to calculate blood pressure. Cardiovascular assessments were obtained via a properly sized occluding cuff positioned on the upper left arm (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992).

Ambulatory Blood Pressure (ABP)

The Oscar II (Suntech Medical Instruments, Raleigh, NC) was used to estimate ambulatory systolic blood pressure (SBP), ambulatory diastolic blood pressure (DBP), and heart rate (HR). The Oscar II was developed to meet the reliability and validity standards of the British Hypertension Society Protocol (Goodwin, Bilous, Winship, Finn, & Jones, 2007). The cuff was worn under the participants' clothing, and only a small control box (approximately 5.0 x 3.5 x 1.5 inches) attached to the participant's belt was partially exposed. Outliers associated with artifactual readings were identified and counted as missing data using the criteria by Marler, Jacobs, Lehoczky, and Shapiro (1988). These included (a) SBP < 70 mmHg or > 250 mmHg, (b) DBP < 45 mmHg or > 150 mmHg, and (c) SBP / DBP < [1.065 + (.00125 X DBP)] or > 3.0.

Ambulatory Diary Record (ADR)

Participants were instructed to complete a series of programmed questions accessed through a secure survey website on Survey Money through their smartphones, tablets, or computers following each ambulatory cardiovascular assessment. The ADR

was designed to be easy to complete (about 2-6 minutes) in order to maximize cooperation. It contained information on basic variables that might influence ABP (Kamarck et al., 1998). These included posture (lying down, sitting, standing), activity level (1 = no activity, 4 = strenuous activity), location (school/work, home, other), talking (no, yes), temperature (too cold, comfortable, too hot), prior exercise (no, yes), and prior consumption of nicotine, caffeine, alcohol, or a meal (no, yes) (for descriptive statistics, see Table 4). Readings were examined to ensure compliance and were discarded if not instigated within 10 minutes of a blood pressure reading. Using the electronic survey allowed automatic date and timestamps of beginning and completion of each individual survey. We subsequently compared these timestamps to ABP assessment times to assess compliance. Compliance using this sampling approach has been good in prior work by our lab (<10% of surveys not completed or noncompliant). In the current study, 2% of surveys were omitted due to noncompliance for being completed after the 10-minute window participants were instructed to observe.

Procedures

Eligible participants arrived at the laboratory on the morning of a typical work or school day. Height and weight were assessed using a Health-o-Meter scale in order to calculate body mass index (BMI) as a covariate. Hip and waist measurements were also collected with a tape measure, as past work suggests that the hip-to-waist ratio is a more accurate index of cardiovascular risk than BMI in Japan (Hara, Saitou, Iwata, Okada, & Harada, 2002). Demographic information and baseline questionnaires were collected on a computer in the laboratory. Participants were then fitted with the ABP monitor by a trained research assistant and given detailed instructions on how to use it, including how

to remove it at the end of the day. They also received detailed instructions on how to access and use the daily diary surveys on their smartphones. One ABP reading was obtained before the participants departed to insure that the monitors are working properly and that participants understand how to correctly complete the ADR. A brief 8-item quiz on the instructions were then administered to participants and checked for accuracy by assistants to ensure participants understood the instructions. An appointment to return the equipment and to receive compensation on 2 days later was set at this time.

Participants completed a 2-day ABP assessment, typically from 8 am to 10 pm, which included working or school hours and 2 evenings at home. The ABP monitor was set to take a random reading once within a 60-minute window. This random interval-contingent monitoring procedure minimizes participants' anticipation of a blood pressure assessment that might lead them to alter their activities. Following each ABP assessment, individuals were instructed to complete questions (ADR, see below) using a survey tool on their smartphones. Participants were instructed to initiate an ADR (see below) within 5 to 10 minutes of each cuff inflation. Upon returning to the lab on day 3, participants received debriefing and compensation and all equipment was returned to the lab.

Analytic Plan

PROC MIXED (SAS institute; Littell, Milliken, Stroup, & Wolfinger, 1996) was used in order to examine ABP (see Schwartz & Stone, 1998). PROC MIXED uses a random regression model to derive parameter estimates both within and across individuals (Singer, 1998). All factors will be treated as fixed (Nezlek, 2008) and PROC MIXED treats the unexplained variation within individuals as a random factor.

One advantage of PROC MIXED is the ability to model more accurate covariance structures for the repeated measure assessments. In the present study, the covariance structure for the repeated measures factor of time, or measurement occasion (i.e., reading number), was modeled. Such repeated measures designs can be handled in PROC MIXED by specifying covariance structures for the random factor (Park & Lee, 2002). Based on the recommendations of Park and Lee (2002), we modeled the covariance matrix for measurement occasion using the "type=ar(1)" option that specifies a decreasing covariance structure between measurement occasions further apart in time for each participant. Importantly, this model allowed us to examine predictors of ABP while controlling for the dependency within measurement occasions. The output of these random regression models were parameter estimates (*b*) and confidence intervals (CI) with the appropriate within-subjects covariance structures considered. As recommended by Campbell and Kashy (2002), we used the Satterthwaite approximation to determine the appropriate degrees of freedom. To account for differences in cultural response sets on self-report measures, predictor variables were person-mean centered (Chen, Lee, & Stevenson, 1995; Cheung & Rensvold, 2000; Heine, Lehman, Peng, & Greenholtz, 2002).

In order to test the mediational pathways proposed in aim 2, bootstrapping mediational analyses was done. We first examined whether social support predicts the psychological well-being and physical health outcomes, then whether social support predicts the self-schema variables, and then if the self-schema variables predict our outcomes after controlling for social support. To test the significance of this indirect effect and moderated mediation for culture, moderated mediation test were conducted

using the SAS PROCESS macro provided by Hayes (2015) (*model*=7, *boot*= 10,000, *percent*= 1, *center*= 1). In these models, the outcome was mental well-being or blood pressure measures, the predictor was the social support variables, the moderator was culture, and the mediator was the self-schema variables.

Statistical Power

To examine power for the ABP assessments with a between-group design (Japan, USA), we conducted Monte Carlo simulations by assuming a moderate effect sizes (*r*=.30) and error structures that corresponded to intraclass correlations between .15 and .2. We tested the model with 150 individuals and 30 measures (over the 2-day ABP protocol) based on our prior ABP work (Sanbonmatsu, Uchino, & Birmingham, 2011). Sufficient power (>.92) is available to detect a significant effect of support.

Table 2

Sociodemographics of participants

	Combined	**Japan (*n*=74)**	**USA (*n*=71)**
Age	18-35 years old 21.58±3.12	18-26 years old 21.24±2.12	18-35 years old 21.93±3.87
Gender	66 males (45.52%) 79 females (54.48%)	45 male (60.81%) 29 female (39.19%)	21 male (29.58%) 50 female (70.42%)
Ethnicity	32.41% Caucasian 7.59% Latino/Hispanic 55.17% Asian-American or East Asian 2.07% African-American 0.69% Pacific Islander 0.69% Native American 1.38% Other	100% East Asian	66.20% Caucasian 15.46% Latino/Hispanic 8.45% Asian-American 4.23% African-American 1.41% Pacific Islander 1.41% Native American 2.82% Other
Education Level	88.28% High school diploma with partial undergraduate studies 11.72% Undergraduate degree completed with partial graduate studies	82.43% High school diploma with partial undergraduate studies 17.57% Undergraduate degree completed with partial graduate studies	95.77% High school diploma with partial undergraduate studies 4.23% Undergraduate degree completed with partial graduate studies
Romantic Relationship Status	51.72% Single 36.55% Dating 3.45% Cohabitating 1.38% Engaged 5.52% Married 1.38% Divorced	64.86% Single 35.14% Dating	38.03% Single 38.03% Dating 7.04% Cohabitating 2.82% Engaged 11.27% Married 2.82% Divorced
BMI	21.10±4.03	19.51±2.67	23.43±4.22
Hip to Waist Ratio	0.85±.20	0.75±.11	0.95±0.09
Hypertension Risk	90.50% Normal 42.60% Pre-hypertension 3.00% Hypertension	91.90% Normal 36.40% Pre-hypertension 2.80% Hypertension	88.73% Normal 47.89% Pre-hypertension 2.80% Hypertension

Table 3

Average blood pressure at baseline

	Combined	Japan	USA
Baseline SBP	117.85±12.77	114.68±13.56	121.36±11.05
Baseline DBP	69.00±9.08	67.56±9.18	70.71±8.90
Baseline HR	73.77±23.60	70.10±10.41	78.16±32.78

Table 4

Descriptive statistics of ADR variables

	Combined	Japan	USA
Interaction	1.63±0.48	1.67±0.47	1.59±0.49
ASBP (mmHg)	128.73±18.20	127.00±17.69	130.56±18.62
ADBP (mmHg)	74.17±12.09	73.42±12.10	75.03±11.98
AHR (mmHg)	74.92±14.05	72.34±13.68	78.05±13.95
Stress	1.7±0.88	1.67±0.85	1.75±1.91
Overall Likert support	1.55±1.00	1.34±0.79	2.06±1.25
Combined support	6.71±1.42	6.83±1.55	6.63±1.29
Emotional support	1.61±0.49	1.70±0.46	1.54±0.50
Informational support	1.65±0.47	1.76±0.43	1.58±0.49
Tangible support	1.86±0.35	1.85±0.36	1.87±0.34
Belonging support	1.70±0.46	1.73±0.44	1.68±0.47
Initiated support	1.61±0.49	1.65±0.48	1.57±0.50
Positive affect	3.23±1.14	2.74±1.08	3.75±0.96
Negative affect	1.43±0.60	1.47±0.62	1.39±0.58
Social self-esteem	0.32±0.64	0.09±0.67	0.57±0.50
Self-esteem	-0.58±0.67	-0.79±0.68	-0.35±0.59

RESULTS

Analysis

First, using PROC MIXED, the data were examined to identify the momentary covariates for ABP. Separate multilevel models were examined for each index of cardiovascular function (ASBP, ADBP, AHR). Momentary covariates significant at $p<.05$ were then included in subsequent models as control variables. For the cultural interaction analyses, ambulatory blood pressure covariates were BMI (ASBP, ADBP), age (ASBP), sex, (ASBP, AHR), location (home vs. work; home vs. other) (ASBP, ADBP, AHR), meal consumption (ASBP, AHR), activity level (ADBP, AHR), alcohol consumption (AHR), whether the person had exercised (AHR), and whether the person was speaking during ABP measurement (ASBP, ADBP, and AHR). Additionally, due to skewed gender distributions in the respective samples (see Table 2), sex was included as a covariate in all models.

Second, we conducted descriptive statistical analyses to examine the compliance rate for participants, the number of diary and ABP readings, and the relative number of social interactions to overall surveys completed, as the social interaction questions were most relevant to the study's aims but were contingent upon a participant experiencing a social interaction lasting longer than 5 minutes in the 60-minute window between ABP measurements (see Table 5).

Next, we conducted the analyses corresponding to the study's primary aims using

multilevel models. Social support variables (the two overall support variables, four types of functional support, and solicited support) were modeled to predict ASBP, ADBP, AHR, positive and negative effect in an interaction with culture (Japan= 1, the U.S.= 2). Stress-buffering effects of social support on these outcome variables were also examined by adding stress as an interaction term in the models.

To examine self-schema variables as mediators of the effects of social support and culture on health, Hayes' (2015) recommendations were followed. For any significant interactions between culture and the social support variables, state self-esteem and state social self-esteem were added to these models in separate tests as a main effect without an accompanying interaction term to determine if the significant culture interactions became nonsignificant upon inclusion of these self-schema variables. If so, moderated mediational analyses would be conducted following Hayes' (2015) recommendations. The SAS PROCESS macro was used for these analyses.

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Soliciting Social Support

There were no support and culture interactions significantly linking solicited support and culture interactions to either physiological or psychological outcome

variables. However, there was a main effect of solicited versus unsolicited support on ASBP, such that – regardless of culture – social support that was initiated by the other person rather than the self was associated with a significant increase in ASBP (*b*(393)= 7.07, *SE*= 2.86, *t*=2.47, *p*=0.01, CI= 1.45, 12.70).

Functional Social Support

Cultural interactions for functional social support. The interaction between culture and belonging support significantly predicted ADBP (see Figure 3) (*b*(438)= 5.69, *SE*= 2.24, *t*= 2.54, *p*=.01, CI= 1.29, 10.10), such that Japanese participants who had received belonging support experienced lower ADBP and U.S. participants who received belonging support experienced higher ADBP. Simple slopes analysis showed that the slopes were significantly different from one another (Japan, slope gradient= -5.27, *t*= -2.84, *p*= 0.01; United States, slope gradient= 0.60, *t*= 2.43, *p*= 0.02). Belonging support also yielded significant main effects for both positive and negative affect independent of culture. Receiving belonging support was associated with higher positive affect (*b*(531)= -0.24, *SE*= 0.11, *t*= -2.27, *p*= 0.02, CI= -0.45, -0.03) and with lower negative affect (*b*(502)= 0.17, *SE*= 0.06, *t*= 2.71, *p*= 0.01, CI= 0.05, 0.30).

The interaction between culture and overall support (Likert-scaled) was significantly associated with AHR (see Figure 4) (*b*(1187)= 1.47, *SE*= 0.77, *t*= 1.89, *p*=.058, CI= -.05, 2.99). Participants from Japan who had received support had higher AHR than those who had not whereas participants from the U.S. who had received support had lower AHR than those who had not received support. However, a simple slopes analysis revealed that the effect among Japanese participants only was driving the significance of this interaction (Japan, slope gradient= -1.93, *t*= -1.96, *p*= 0.05; United

States, slope gradient= -0.46, *t*= -0.68, *p*= 0.50). There was also a main effect for overall support (reported on a Likert scale) on AHR without any significant cultural interactions, such that participants who felt they had received more support in the past hour had lower AHR (*b*(1236)= -1.25, *SE*= 0.54, *t*= -2.31, *p*= 0.02, CI= -2.30, -0.19).

There was also a three-way interaction significantly predicting AHR between social support (Likert-scaled), stress, and culture (see Figure 5) (*b*(1137)= -1.59, *SE*= 0.82, *t*= -1.94, *p*=.052, CI= -3.19, 0.02). A simple slopes analysis revealed that the significance of the three-way interaction was due to the effect between Japan and the United States during low stress (Japan versus United States, *t*= 2.49, *p*= 0.01). During low stress, Japanese participants had lower AHR when support was received than when it was not, whereas in the United States, during low stress, participants who received support had higher AHR than U.S. participants who had not received support. Importantly, there was no significant difference between not receiving support on AHR under high or low stress. A significant main effect of support was part of this model, predicting lower AHR after receiving support (*b*(1245)= -1.32, *SE*= 0.55, *t*= -2.40, *p*=.02, CI= -3.89, -0.48). Additionally, the significant interaction between overall support and culture aforementioned was replicated within this model (*b*(1194)= 1.55, *SE*= 0.28, *t*= 1.97, *p*=.05, CI= 0.01, 3.08).

Mediation. Using the SAS PROCESS MACRO, moderated mediation analyses using bootstrapping mediation estimates were run. Per Hayes (2015), the bootstrapping confidence intervals were examined as evidence of moderated mediation. Sample sizes varied, ranging from *n*= 426 to *n*= 2,309, depending on the social support independent variable used in a particular model, due to differing frequencies of occurrence. All

confidence intervals in the analyses contained “0” within the lower and upper limits; as such, there was no evidence for mediation effects in the study.

Secondary Exploratory Analysis

Due to the novel nature of the study and the possible role of effect size and power in the current dataset (affected by missing data), we replicated past procedures (Uchida et al., 2008) and examined the same models within-country. The ambulatory blood pressure covariates were examined for each country separately and controlled for accordingly in the respective models. In the U.S., ambulatory blood pressure was predicted by BMI (ASBP), age (ASBP, AHR), sex (AHR), posture (sitting vs. standing; sitting vs. lying down) (ASBP, ADBP, AHR), location (home vs. work; home vs. other) (ADBP), and activity level (AHR). In Japan, ambulatory blood pressure was predicted by BMI (ASBP, ADBP), age (ASBP, ADBP, AHR), sex (AHR), posture (sitting vs. standing; sitting vs. lying down) (ASBP, ADBP, AHR), change in temperature from comfortable to cold (ASBP), location (home vs. work; home vs. other) (ASBP, ADBP, AHR), food consumption (ASBP, AHR), activity level (ASBP, ADBP, AHR), and whether they were speaking during the ABP measurement (ASBP, ADBP, AHR).

Soliciting social support. In Japan, unsolicited support was associated with higher negative affect than solicited support (*b*(217)= 0.03, *SE*= 0.01, *t*= 2.55, *p*=.01, CI= 0.01, 0.05). In the United States, solicited support was not associated with any outcomes.

Functional social support in Japan. Receiving informational (ASBP [*b*(184)= -3.63, *SE*= 1.73, *t*= -2.10, *p*=.04, CI= -7.05, -.22]; ADBP [*b*(217)= -2.67, *SE*= 1.38, *t*= -1.93, *p*=.05, CI= -5.39, 0.06]) and belonging social support (*b*(249)= 2.91, *SE*= 1.40, *t*= 2.08, *p*=.04, CI= 0.15, 5.66) were significantly associated with outcomes (see Figures 6,

7, and 8). Informational support was associated with higher ASBP and ADBP. Belonging support predicted lower ADBP among participants, confirming one of our hypotheses.

There was a significant association between overall support (combining all four functions) and ADBP such that higher overall support predicted lower ADBP (*b*(960)= 1.05, *SE*= 0.42, *t*= 2.47, *p*=.01, CI= 0.21, 1.88). While there was not a significant main effect of tangible support, it significantly predicted ADBP in an interaction with stress (*b*(234)= -5.70, *SE*= 2.28, *t*= -2.51, *p*=.01, CI= -10.18, -1.22). The pattern of this interaction did not support the stress-buffering hypothesis. When participants were under higher stress, receiving tangible support increased ADBP relative to participants who did not receive tangible support during stress. Under lower stress, participants appeared to benefit from tangible support with reduced ADBP relative to no tangible support (see Figure 9). Simple slopes analysis indicated that the slopes were significantly different at both high and low stress in situations where participants did and did not receive tangible support (high stress, slope gradient= -4.12, *t*= -2.23, *p*= 0.03; low stress, slope gradient= 7.50, *t*= 3.42, *p*= 0.001).

Overall support (combined functions) (*b*(362)= -0.05, *SE*= 0.02, *t*= -2.54, *p*=.01, CI= -0.10, -0.01) and informational support (*b*(278)= -0.30, *SE*= 0.06, *t*= -4.85, *p*=<.0001, CI= -0.42, -0.18) predicted higher negative affect.

Functional social support in the United States. Overall support (combined functions) predicted higher AHR [*b*(277)= -1.12, *SE*= 0.54, *t*= -2.07, *p*=.04, CI= -2.18, -0.05] (see Figure 10). Tangible support was associated with higher ADBP [*b*(221)= 3.49, *SE*= 1.64, *t*= 2.13, *p*=.03, CI= 0.26, 6.73]. There were also a number of stress-buffering effects of support on ASBP (overall combined functional support [*b*(241)= -1.76, *SE*=

0.82, *t*= -2.15, *p*=.03, CI= -3.37, -0.15], overall support [*b*(255)= 1.45, *SE*= 0.03, *t*= 2.24, *p*=.03, CI= 0.17, 2.72], emotional support [*b*(275)= -4.48, *SE*= 1.99, *t*= -2.25, *p*=.03, CI= -8.39, -0.56], and belonging support [*b*(219)= -4.17, *SE*= 2.01, *t*= -2.08, *p*=.04, CI= -8.12, -0.22],) (see Figures 11, 12, 13, and 14). For both emotional support (high stress, slope gradient= 5.23, *t*= 3.33, *p*= 0.002; low stress, slope gradient= -3.89, *t*= -1.68, *p*= 0.10) and belonging support (high stress, slope gradient= 3.66, *t*= 2.58, *p*= 0.01; low stress, slope gradient= -4.40, *t*= -1.81, *p*=0.08), simple slopes analysis indicated that support's effects were only significant at high, but not low, levels of stress. That is, only during high stress, participants who received either emotional or belonging support had smaller increases in ASBP than participants who did not receive social support. The simple slopes analysis for both overall support variables were only marginally significant when examined at high and low stress (overall combined support high stress, gradient slope= -8.22, *t*= -1.84, *p*=0.07; low stress, gradient slope= 8.98, *t*= 1.89, *p*= 0.06; overall Likert support high stress, slope gradient= 6.79, *t*= 1.70, *p*= 0.10; low stress, slope gradient= -7.71, *t*= -1.82, *p*= 0.08).

Discussion

The primary aim of this study was to examine (a) whether the effects of solicited versus unsolicited received social support on mental well-being (e.g., positive and negative affect) and physical health (e.g., ambulatory blood pressure) were moderated by culture, and (2) whether this moderation was mediated by changes to self-schema variables most relevant to each cultural context (e.g., independent and interdependent contexts). The study also aimed to examine the contextual contributions of functional social support and stress-buffering effects of social support on these larger associations.

We predicted that interdependent cultural contexts, such as Japan, would exhibit fewer health costs (e.g., higher negative affect, lower positive affect, higher ambulatory blood pressure) when received social support was unsolicited rather than solicited and when such received social support raised state social self-esteem. On the other hand, we predicted that within independent cultural contexts, such as the United States, received social support that was solicited rather than unsolicited would result in fewer health costs and that such received social support effects would be mediated by support increasing state self-esteem.

We also predicted that functions of support that were most specifically targeted the self-schema variables relevant in a particular context (e.g., belonging support raising social self-esteem in an interdependent context and emotional support raising self-esteem in an independent context) would be associated with fewer health costs, independent of solicitation. Finally, this study predicted that – consistent with past work – these effects of support on health would particularly occur when participants were experiencing higher stress, such that support would serve as a stress-buffer.

Overall, we found no consistent evidence for the role of cultural moderation of solicited and unsolicited social support's differential effects on health. When these variables were examined independently within each sample as main effects, there was also no consistent evidence for our hypotheses. Furthermore, the study did not provide support for support's effects on health being mediated by changes to self-schema variables in either cultural sample.

However, the current study did replicate prior cross-cultural work, in that informational support was associated with negative outcomes (e.g., higher blood

pressure) and belonging support was associated with beneficial outcomes (e.g., lower blood pressure) among East Asian participants, above and beyond European-American participants (e.g., the effects on negative affect).

Interestingly, there was a significant interaction between tangible support and stress in predicting ADBP among Japanese participants, such that receiving tangible support during high stress times led to increased ABP, but not during low stress. This may converge with past theories that the reason that East Asian participants experience more decreases in well-being from receiving support is due to concerns over relational debt or loss of face (Uchida et al., 2008). If participants received tangible support (e.g., instrumental aid) during higher stress times, relational debt or loss of face may be more apparent as the recipient is under duress and has an imperative need to receive. However, receiving tangible support during low stress periods predicted lower ADBP. This may be due to higher reciprocity norms among East Asian participants, such that receiving tangible support is part of the normal exchange between close social ties.

Similarly, this study replicated past work among participants in the United States, as receiving social support during times of high stress predicted smaller increases in ABP than not receiving social support during stress, whereas the differences in effects of receiving support were nonsignificant for participants low in stress. However, given that in a number of significant stress-buffering interactions, ABP was higher during low stress than high stress, caution in the confidence with which we interpret these findings is emphasized.

There are several conceptual and methodological issues to consider for the current study. First, we conducted power analyses for the current study based on estimates from

past work. However, although participants' compliance for observing the 10-minute window to complete an online survey after an ABP measurement, participants' compliance for missing data was substantially lower. Given that participants did not encounter a social interaction – particularly a social interaction in which social support occurred – within every hour of an ABP measurement, our total number of observations for both samples was smaller than power analyses estimated. Thus, it is possible that the current findings lack adequate statistical power for the hypotheses we wish to test, particularly given the complexity of multilevel models with interactions and mediation. Second, participants who failed to complete the online ADR often reported at debriefing that between the hours of 16:00 and 20:00, these participants had social activities that led to temporarily abstaining from the study procedures (e.g., skipping diaries). However, these few hours may have contained a number of important social interactions most relevant to the current study. Thus, future studies might consider how to modify study procedures to ensure higher compliance.

Second, past cross-cultural work shows that there are differences between the United States and Japan in response sets to Likert-styled self-reports. More specifically, participants from the United States are more likely to use an extremity response set, particularly toward positive response or an acquiescence set (Heine et al., 2002). In contrast, participants from Japan have been shown to more commonly endorse midpoints of a Likert-scale with less drastic shifts in responses. However, these past studies have primarily examined these response differences in measures of individual differences or traits, which have greater stability. The current study's time scale was significantly shorter and the ADR focused on state levels of the variables. While descriptive statistical

analyses show similar means and standard deviation on ADR variables in both samples, and while potential response sets are somewhat corrected with person-mean centering, it is less understood how cultural differences in response styles influence state levels of variables and ecological sampling data. As such, it is possible that the study's current findings have been influenced by these response sets, which leads to a loss of statistical power.

Third, due to concerns over participant burden leading to reduced compliance, the current study limited the variables on the ADR. The current study only included self-esteem measures in the ADR. Based on past work, future studies might consider extending measures to include self-efficacy, autonomy, group efficacy, and other related self-schema variables, as they may be more relevant to stress contexts (Tomaka, Blascovich, Kelsey, & Leitten, 1993). Additionally, the current study did not include items regarding social contexts (support-seeking, mere presence, etc.). Thus, it is possible that social support affects well-being differently depending upon such contexts (Uchino et al., 2012). However, such a consideration was not included in our present models, and may potentially mute present effects. Similarly, past work has contrasted received social support by visible and invisible support, showing that participants often do not notice when others provide social support, even during stress. Furthermore, invisible support is more consistently associated with improved health (Bolger et al., 2000). The current study did not assess possible invisible support; thus, it may be possible that participants received invisible support, with effects on our hypothesized outcomes. As this remains an unmeasured aspect of support in this study, however, it is not possible to make any conclusions about these effects.

Fourth, conceptual discussions of cross-cultural work have included an important concern over etic versus emic approaches. For example, conceptualizations of social support functions and what constitutes soliciting social support may differ or be greatly nonequivalent across the cultural contexts in which this study was conducted, as the questions in the current study are derived from theoretical frameworks developed in an independent cultural context.

Finally, a significant criticism of past cross-cultural studies has been the use of country as a proxy for culture. The current study makes the assumption that participants in Japan and the United States – by virtue of their country of residence – significantly and systematically differ from one another in the dimension of independence and interdependence. However, existing evidence shows that generational, regional, and gender differences may influence this dimension (Oishi, 2010). In addition to individual difference measures of individualism, collectivism, agency, and communalism, pervasive cognitive differences (holism-analytics) as well as residential mobility may be a macro-level of culture and a proximal index of culture, respectively, that more closely capture the underlying cultural dimension of independence-interdependence (Oishi, 2010). As such, future studies should include multiple measures of constructs that correspond to independence and interdependence in order to serve as converging evidence and a manipulation check for cultural differences at the country level.

However, there are a number of important contributions this study makes to the existing literature. This study was the first of its kind to examine the cultural effects of received social support occurring within real relationships on psychological health and direct measures of physiological health in daily life. Furthermore, prior studies have

relied upon one-time measurement or self-report approaches. The current study extends past work by examining repeated physiological and psychological measurements. Importantly, the predicted ABP values in the significant findings showed differences in blood pressure great enough to predict changes in cardiovascular risk (MacMahon et al., 1990). Additionally, prior work on social support, health, and culture revealed complex findings that are mixed with regard to whether support is beneficial or harmful to well-being. This study replicates some of these past findings, while also testing the feasibility of a cross-cultural ecological sampling and physiology protocol.

Table 5

Frequency table of ADR variables

	Combined	Japan	USA
Total Number of ADR	2580	1340	1240
Total Number of ABP	4366	2376	1990
Number of ABP without ADR	1786	1036	750
Number of ADR with no social support	1778	1028	750
Frequency of overall support	946	340	606
Frequency of emotional support	302	107	195
Frequency of informational support	265	84	181
Frequency of tangible support	109	53	56
Frequency of belonging support	233	96	137
Frequency of initiating support (self)	232	84	148

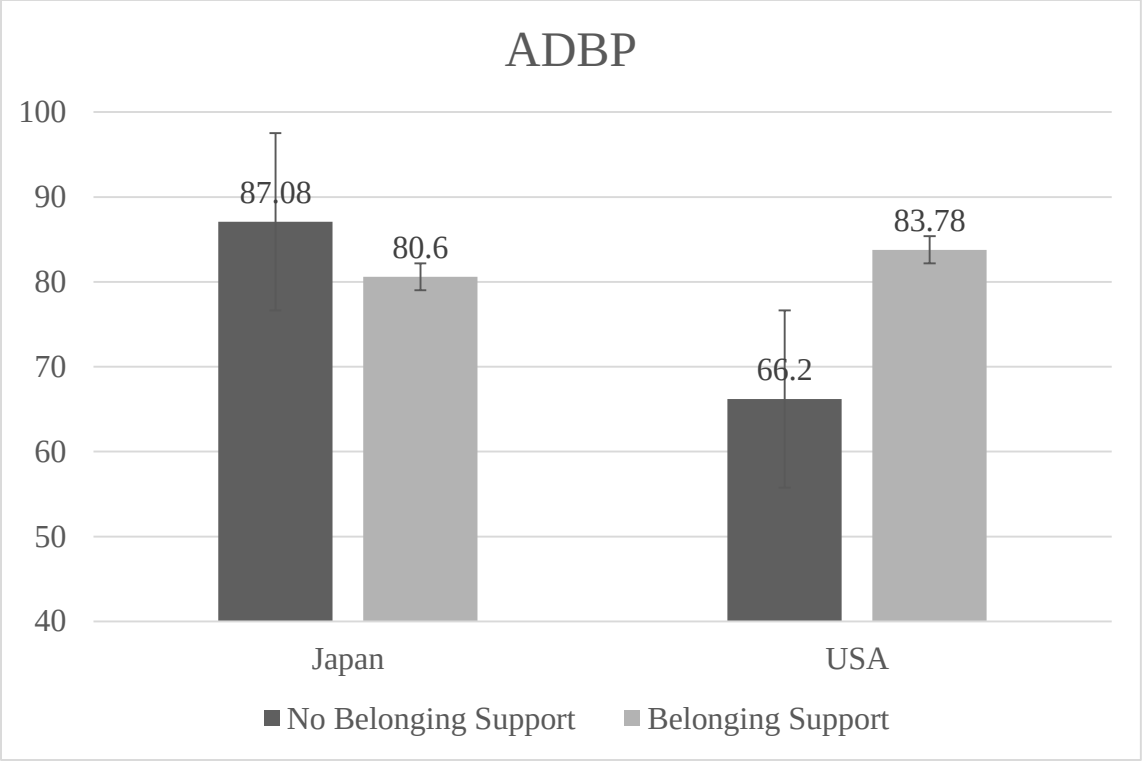

Figure 3 Cultural effects of belonging support on ADBP.

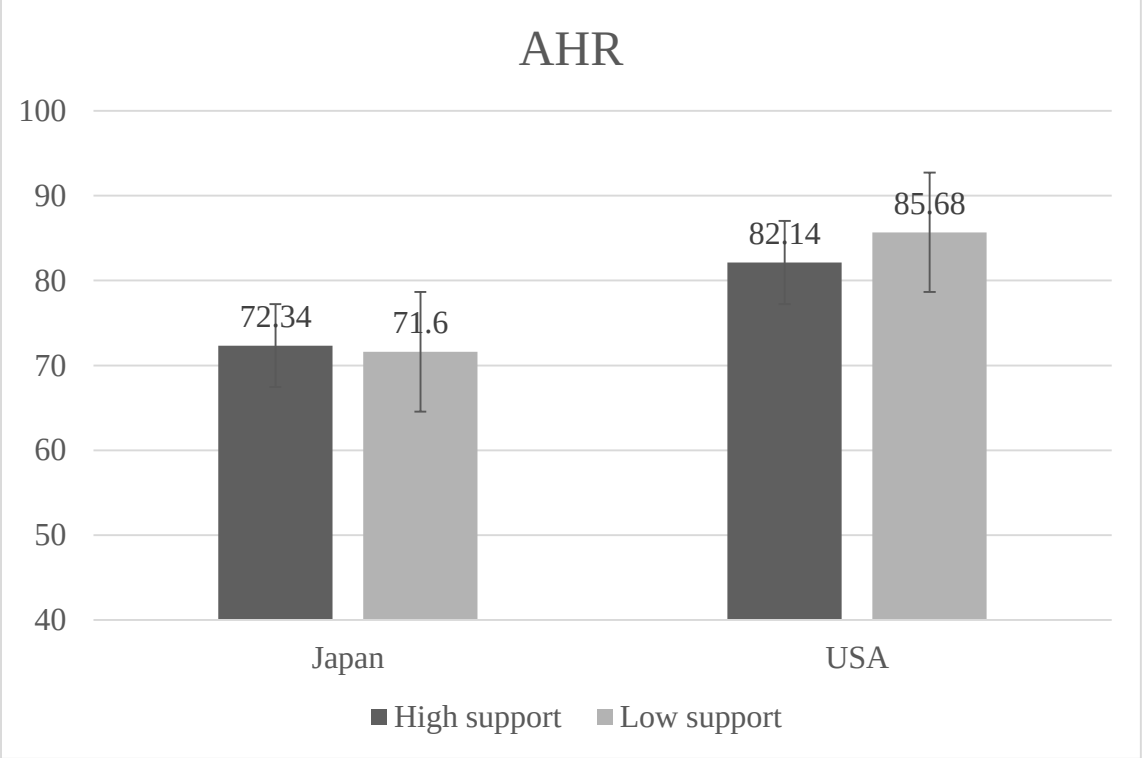

Figure 4 Cultural effects of overall support (combined function) on AHR.

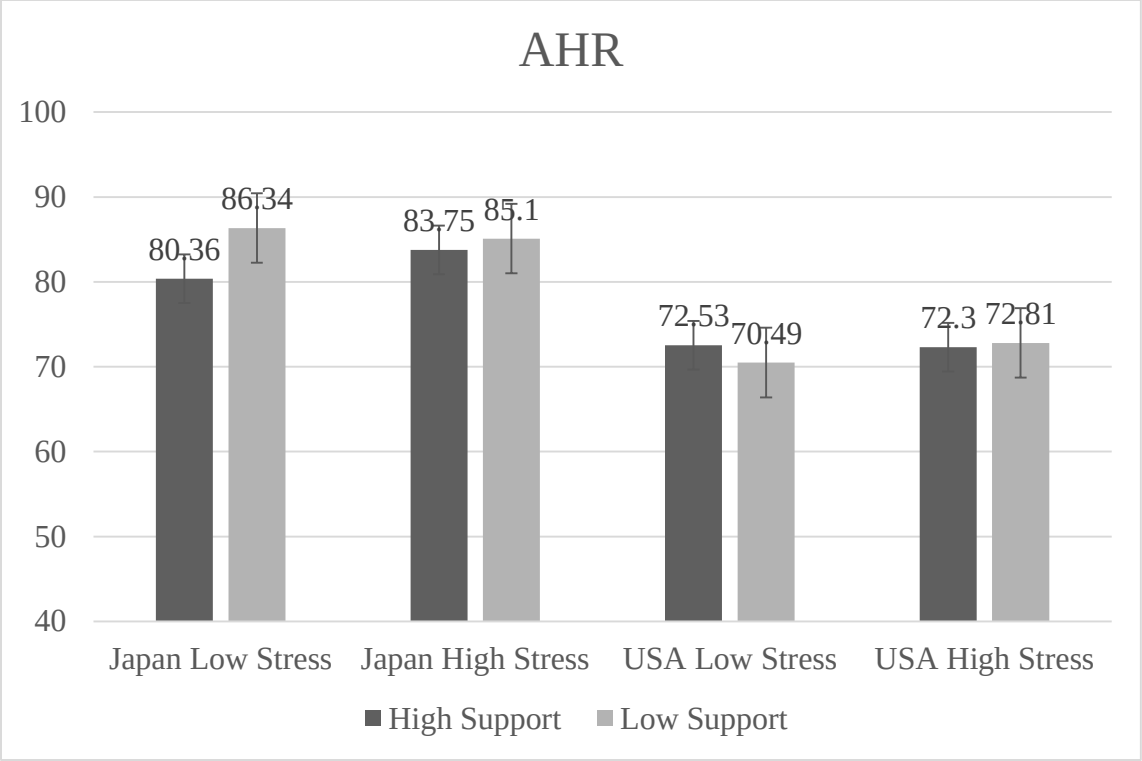

Figure 5 Cultural effects of overall support (combined functions) and stress on AHR.

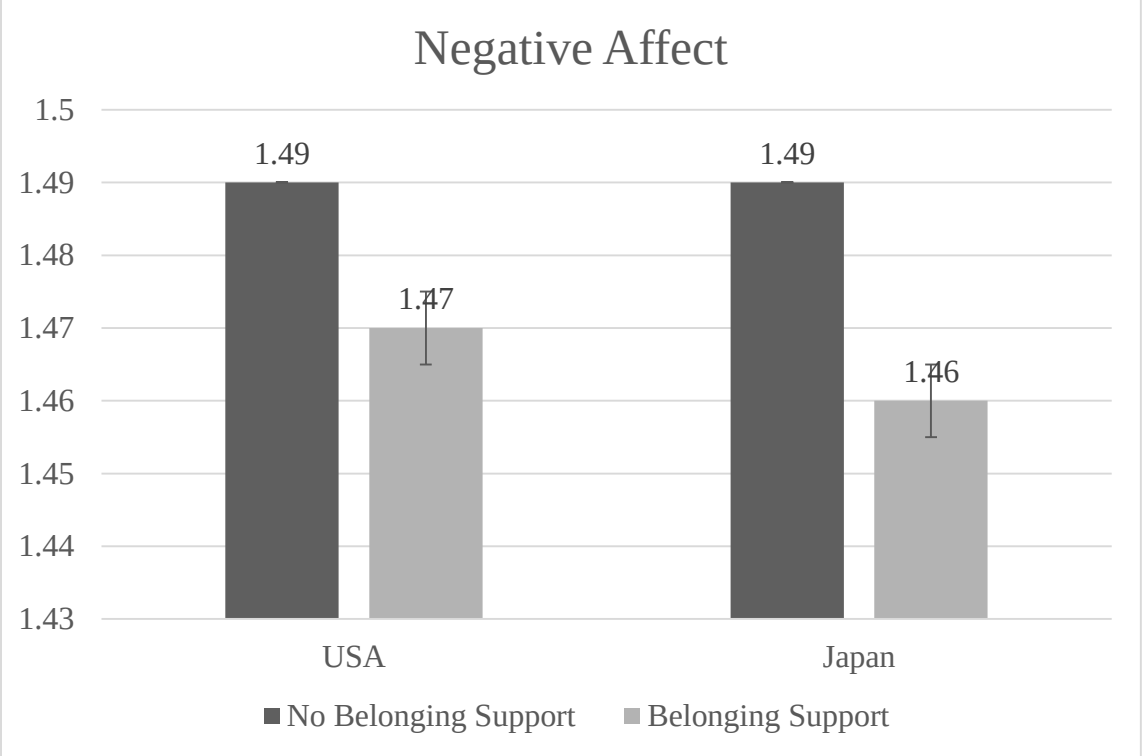

Figure 6 Belonging support and culture on negative affect.

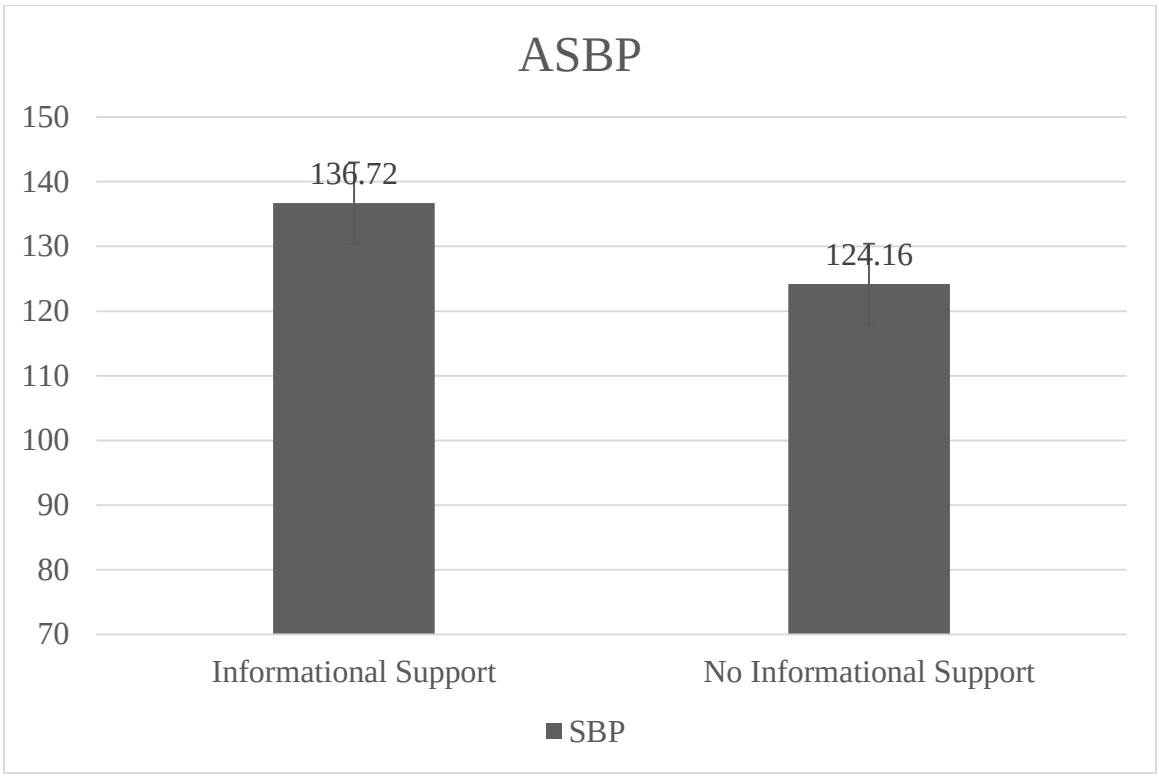

Figure 7 Informational support and ASBP in Japan.

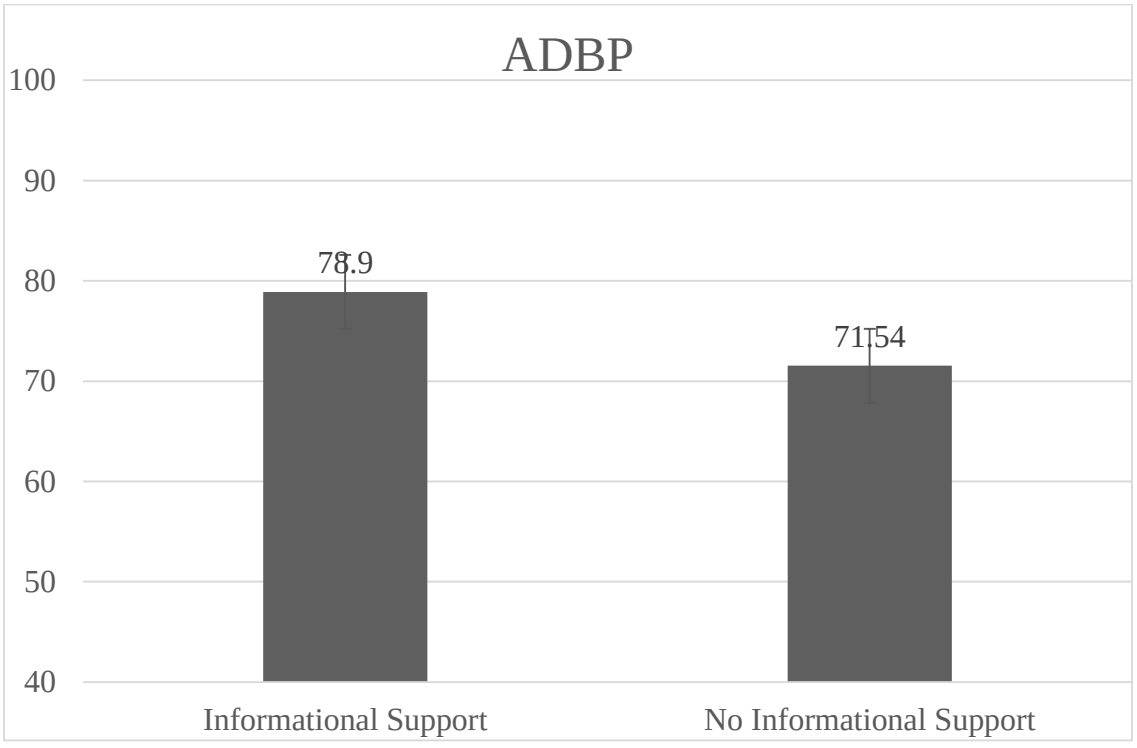

Figure 8 Informational support and ADBP in Japan.

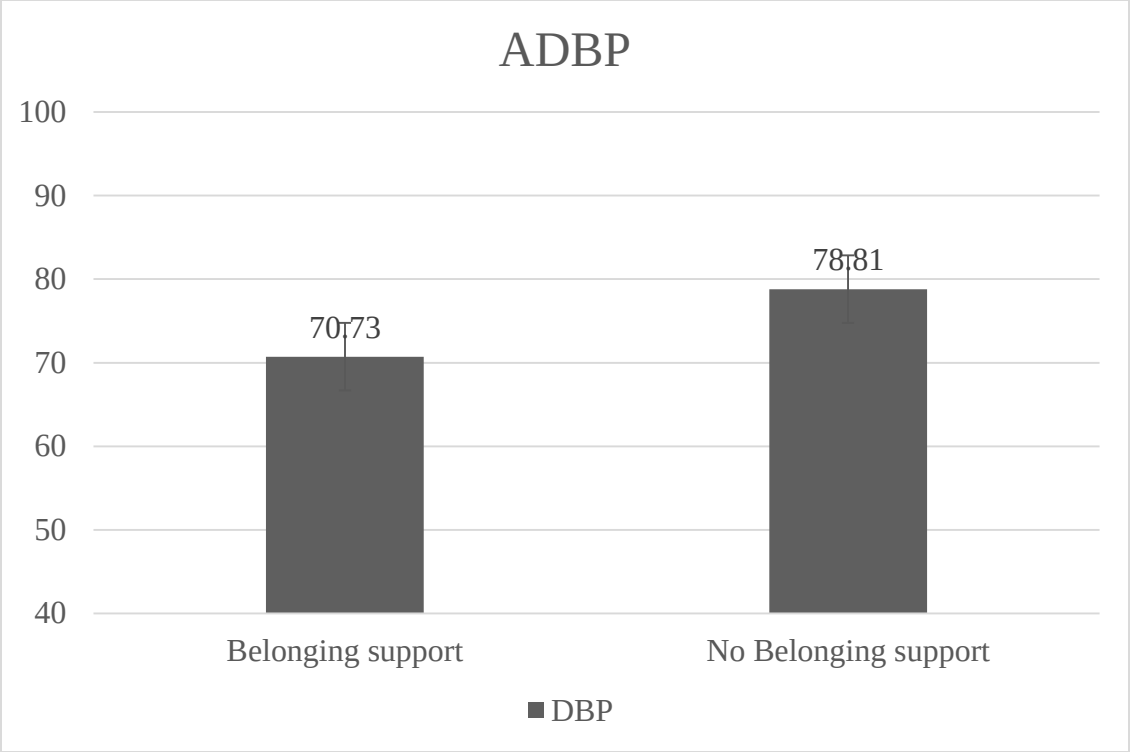

Figure 9 Belonging support and ADBP in Japan.

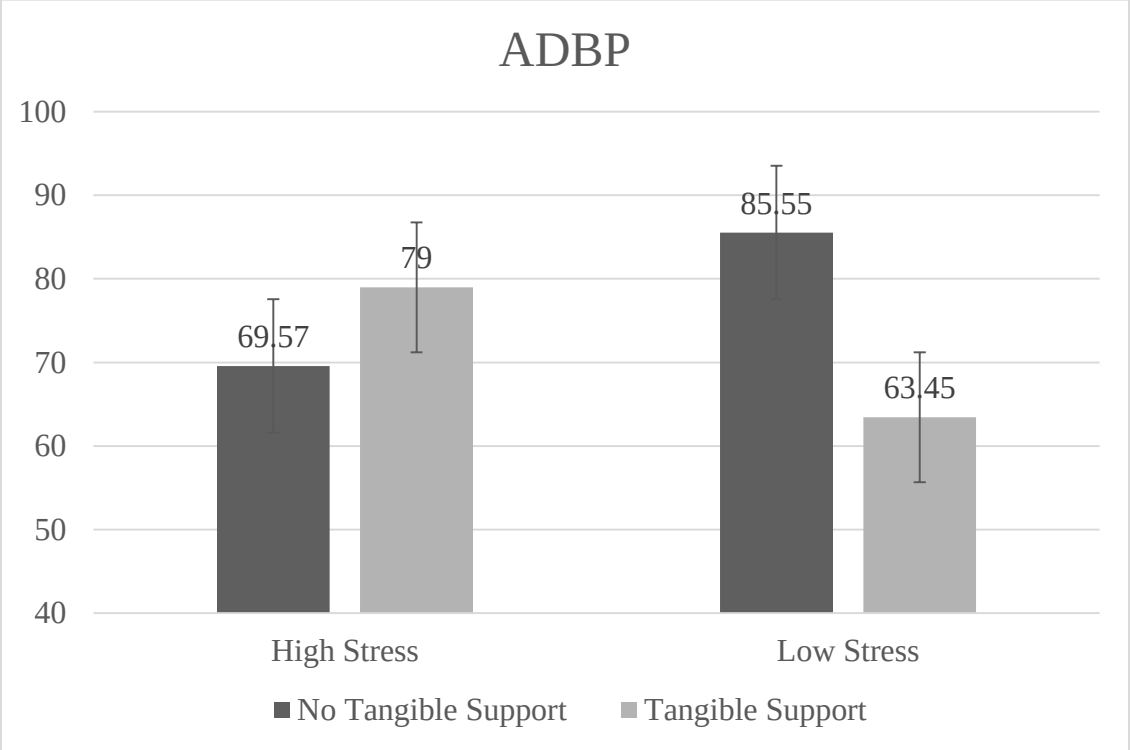

Figure 10 Tangible support and stress on ADBP in Japan.

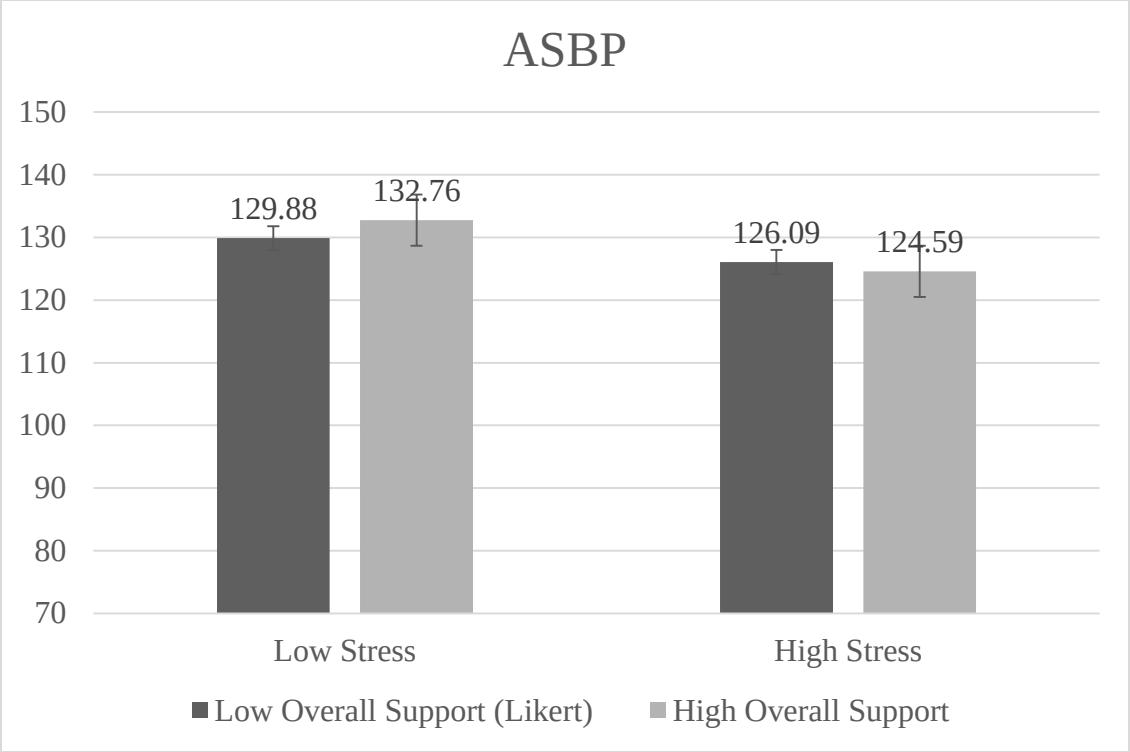

Figure 11 Overall support (Likert-scaled) and stress on ASBP in the United States.

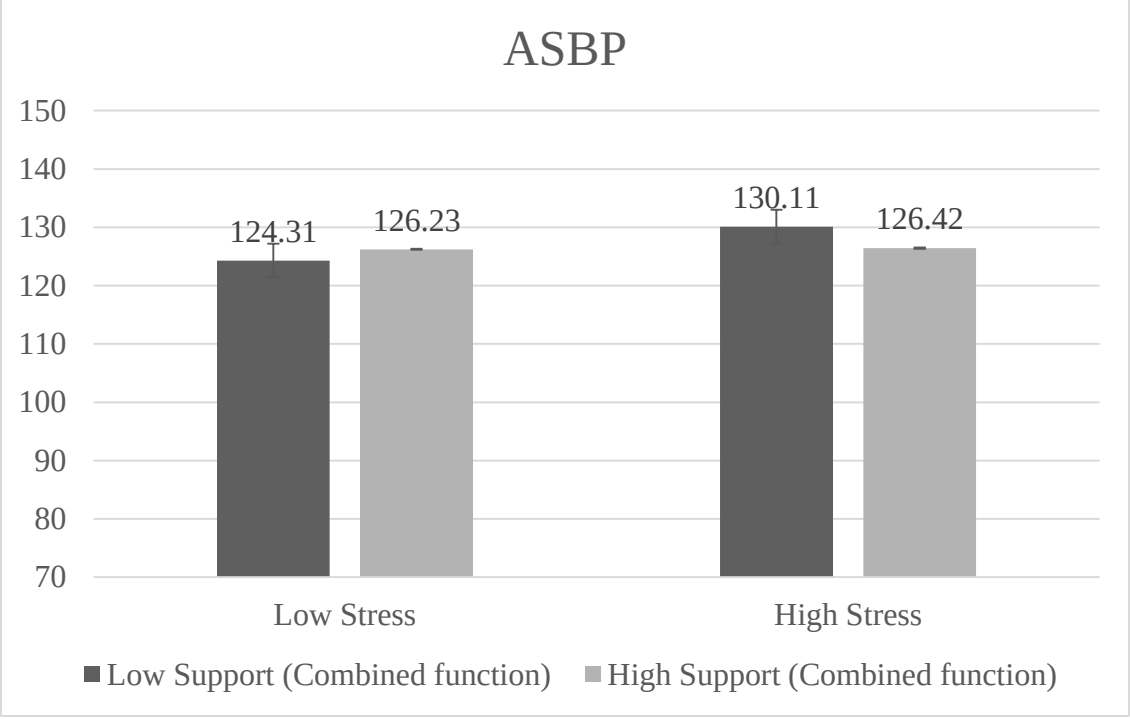

Figure 12 Overall support (combined functions) and stress on ASBP in the United States.

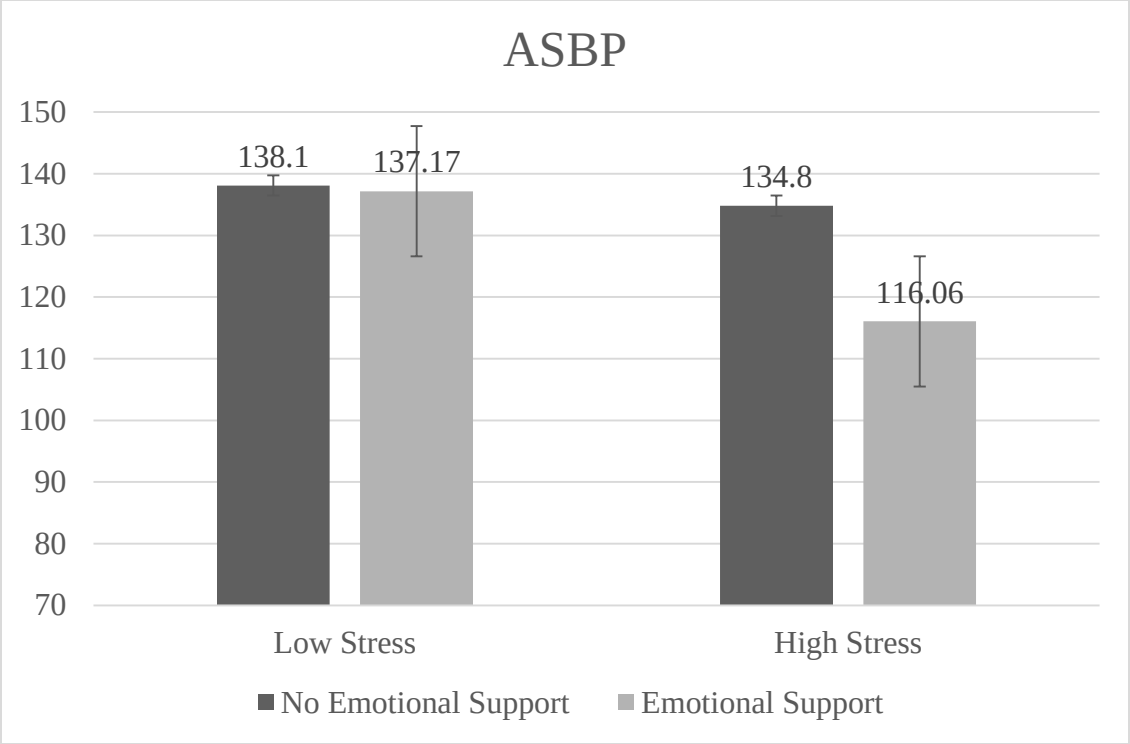

Figure 13 Emotional support and stress on ASBP in the United States.

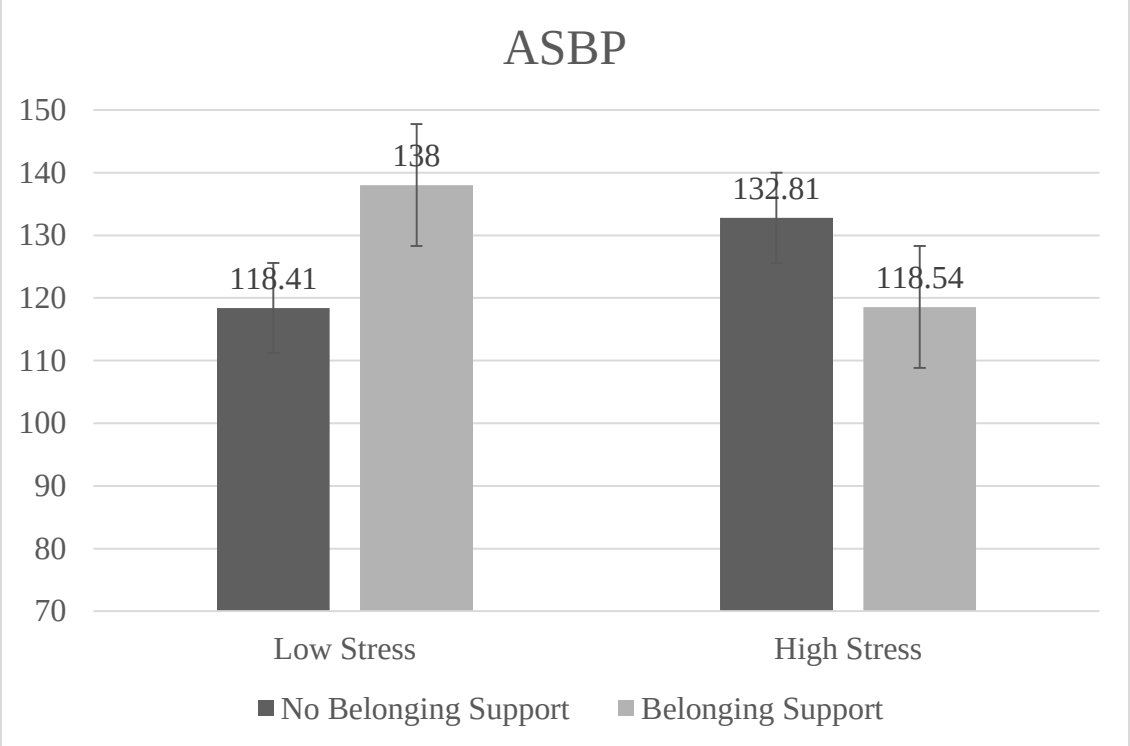

Figure 14 Belonging support and stress on ASBP in the United States.

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